

# The effect of hearing aid technologies on listening in an automobile

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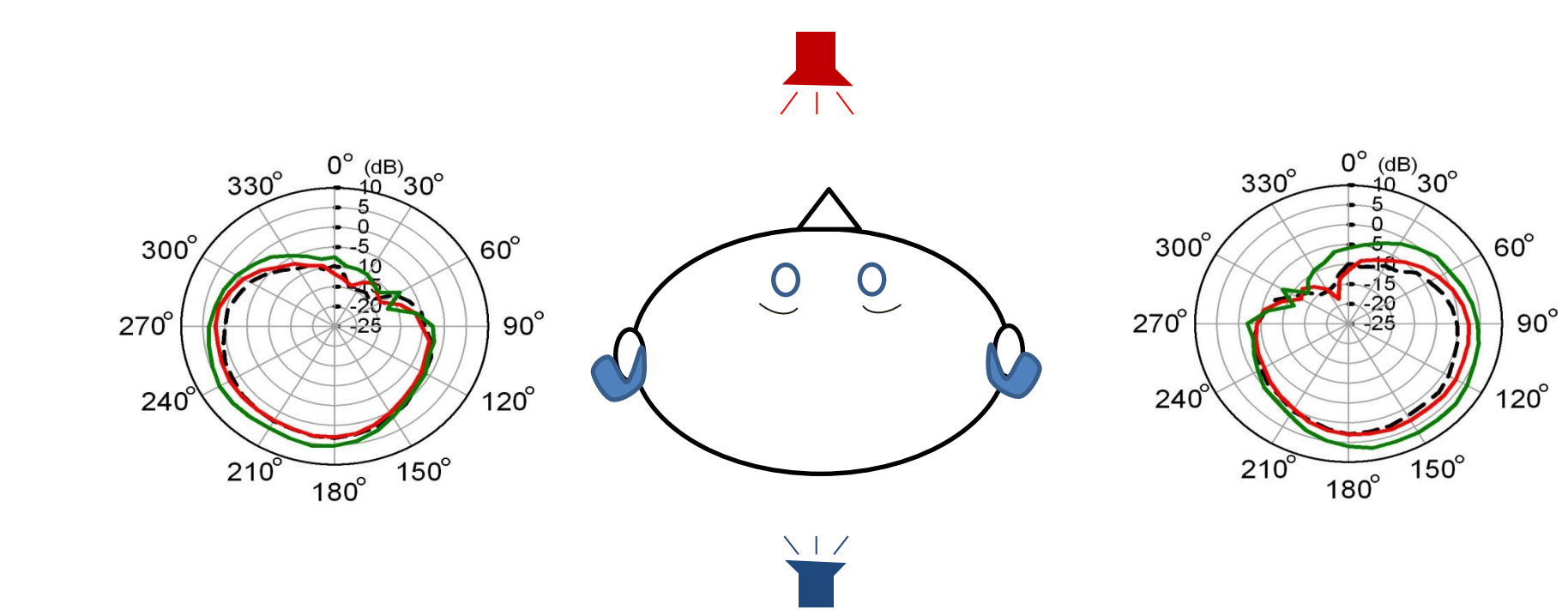
## INTRODUCTION

- Difficulty understanding speech in the presence of background noise is one of the most common complaints of hearing aid users.
- Although directional (DIR) technology could improve signal-to-noise ratio (SNR), its success is based on the assumption that the listener could place the speech source at the direction that DIR microphones are most sensitive.
- In situations such as driving a car, the speaker is either behind or to the side of the listener. Traditional DIR technology designed to enhance speech arriving from listener's front does not aid in speech recognition in these situations.
- The purpose of this study was to compare the effectiveness of three new hearing aid technologies that may aid speech recognition in the car.

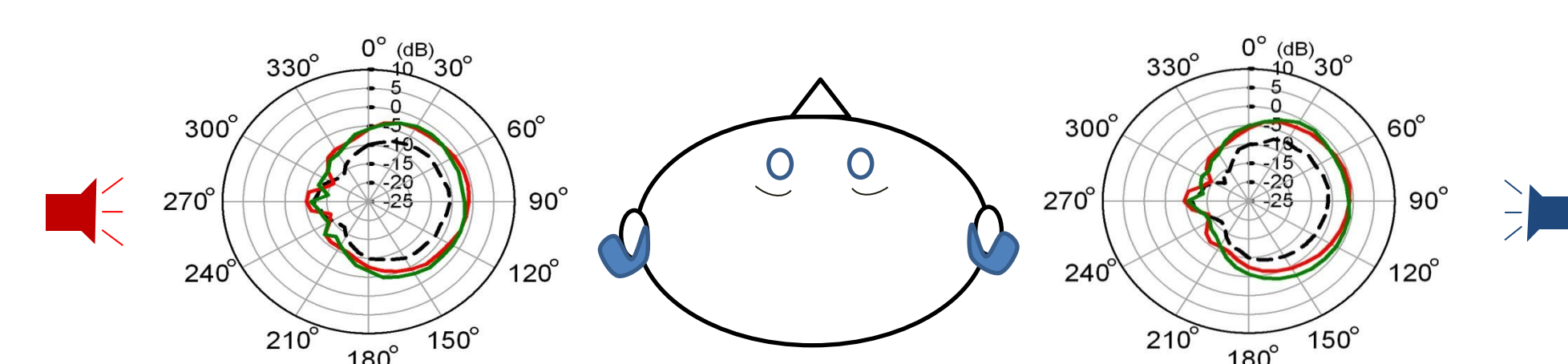
## METHODS

### Hearing Aids

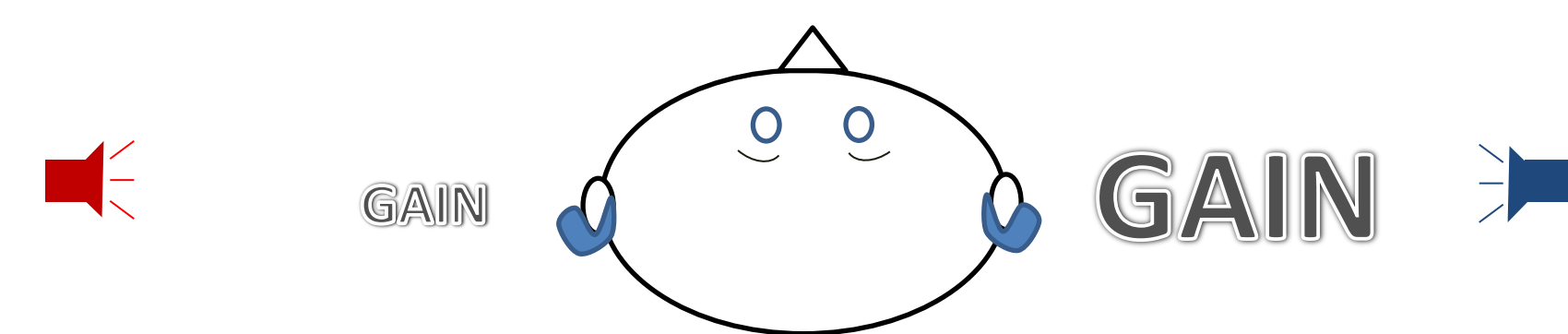
- HA1: "Back-DIR" technology



- HA2: "Side-Transmission" and "Back-DIR" technologies



- HA3: "Side-Suppression" processing



## METHODS

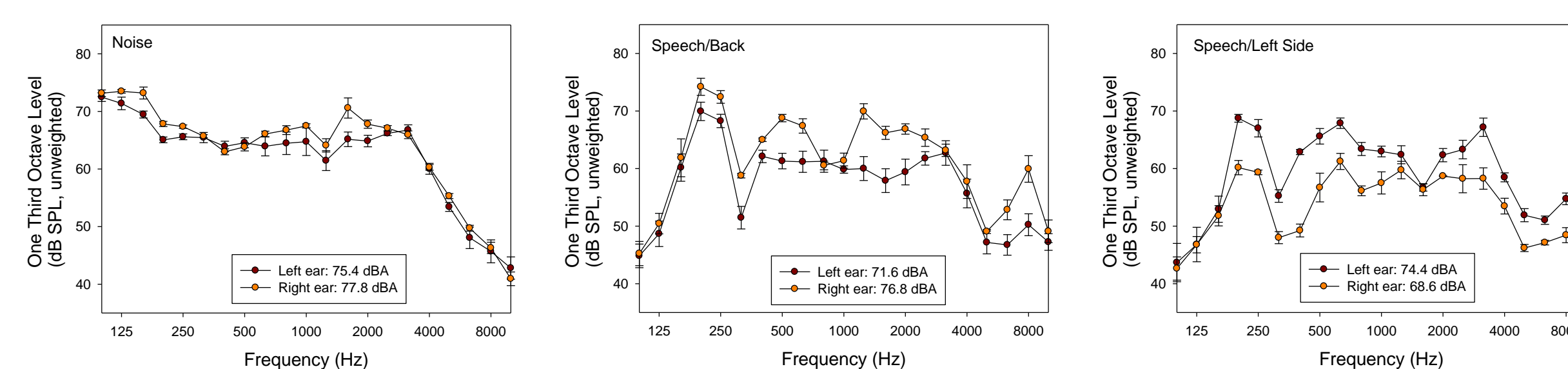
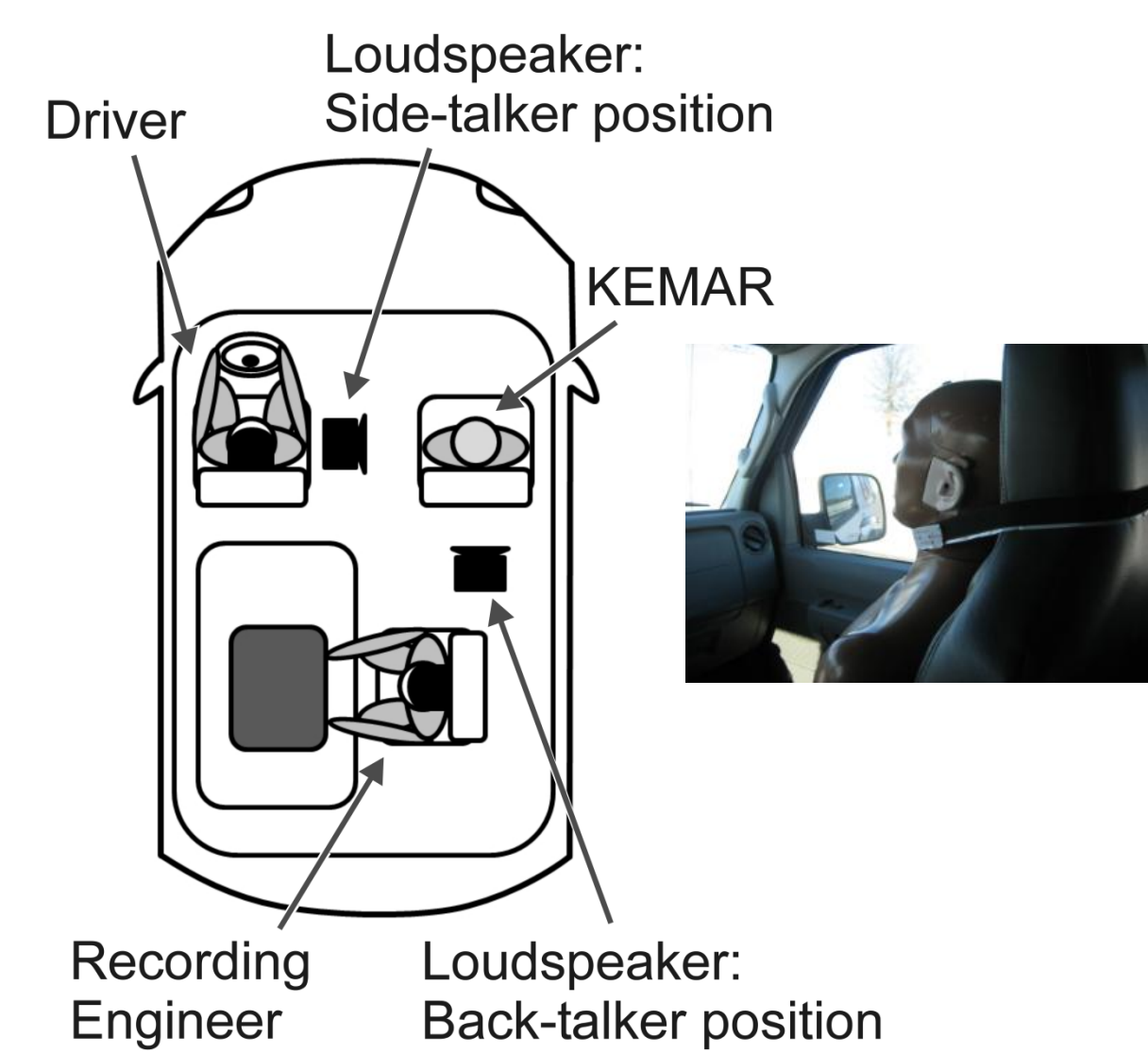
- The hearing aids were set to fit a mild-to-moderate sloping hearing loss. Each hearing aid had three programs, one for each technology:
  - omnidirectional processing (OMNI)
  - adaptive directional processing (DIR)
  - new technology (NewTech)
- Digital noise reduction (DNR) algorithms remained active.

### Subjects

- Twenty-five adults/ Age 44-84 (mean = 70.5)/ 10 Males, 15 Females
- Bilateral symmetric sensorineural hearing loss

### Recording

- Connected Speech Test (CST) sentences/side or back /70 mph.
- The noise level was approximately 76 dBA.
- The level of CST sentences was set to achieve an SNR of -1 dB at the ear that had a better SNR.

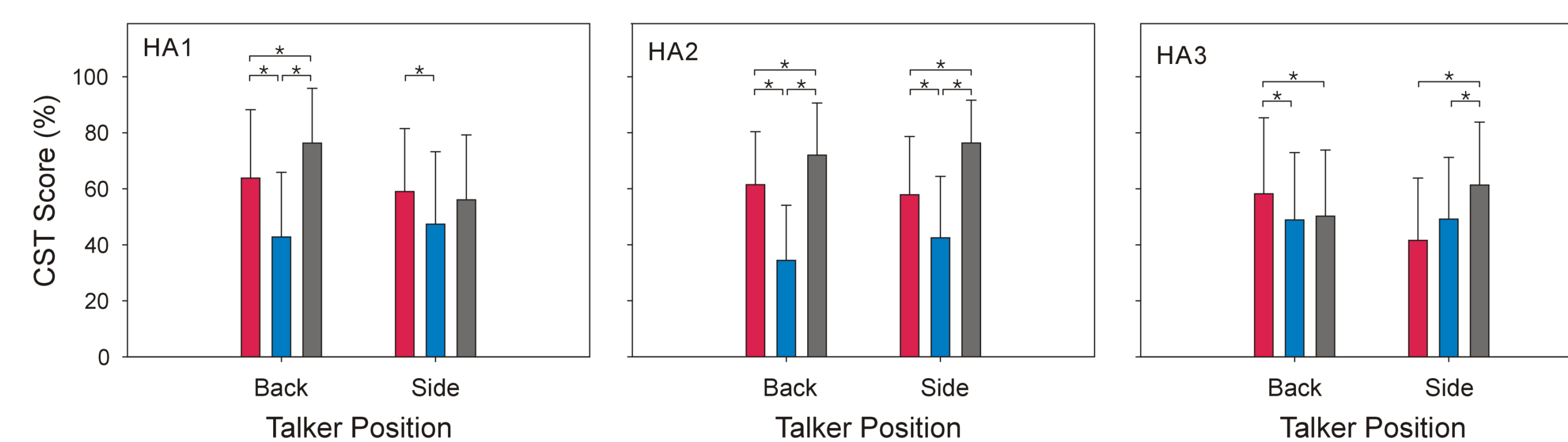


### Procedure

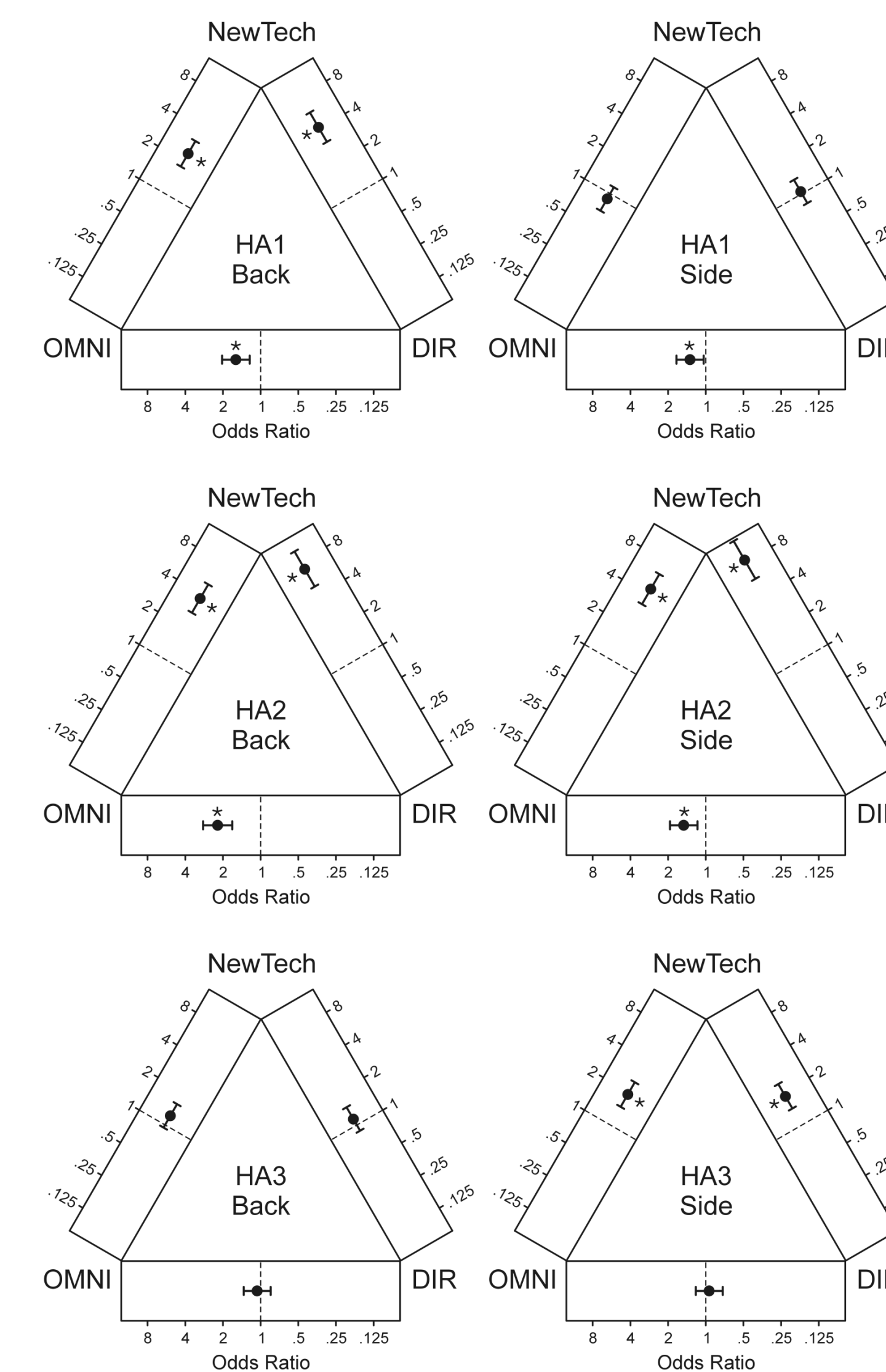
- The recorded hearing aid outputs were adjusted for the hearing loss of individual subject using NAL-NL1 targets and served as stimuli.
- In a sound treated booth, the stimuli were presented to subjects bilaterally using Sennheiser IE 8 earphones.
- Speech recognition scores were determined.
- User preference was determined using a paired comparison paradigm.
  - The three technologies were compared within each hearing aid.
  - The comparison between given two technologies was repeated 10 times.

## RESULTS

### Speech Perception



### Paired Comparison



## DISCUSSION

- In general, speech perception data were consistent with paired comparison data.
- For the back-talker position:
  - For all hearing aids, DIR had a detrimental effect on speech perception and user's preference relative to OMNI.
  - Because backward directivity improved SNR, the NewTech of HA1 and HA2 provided better speech perception performance and were preferred.
- For the side-talker position:
  - For HA1 and HA2, DIR had a detrimental effect.
  - Only HA2's NewTech, which optimized the SNR of both ears, could improve speech perception.
  - The speech perception result of HA3 was less conclusive because of the low score in the OMNI mode. This may have been a result of inconsistent road noise.
  - However, listeners seemed to prefer HA3's NewTech over the OMNI and DIR modes.

## CONCLUSIONS

- In noisy listening situations when the talker is not in front of the listener, a traditional automatic or adaptive DIR modes could be detrimental to speech understanding.
  - OMNI microphones could be better in these situations.
  - Therefore, it is important to counsel hearing aid users to try different microphone modes in different environments.
- The current study suggests that, in car listening conditions with one speech source, new technology has the potential to improve speech understanding and could be preferred by listeners.
- The improved speech understanding may also help improve driving safety. Our next study tests speech perception and driving safety in a simulated driving environment.

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